

Chromophoric dissolved and particulate organic matter cycling through a tidally influenced restored marsh ecosystem in Eastern North Carolina

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1. Introduction

- Fluorescence is an optical technique capable of discriminating between the chemical composition of chromophoric dissolved organic matter (CDOM)
- Organic matter can be continuously transformed between the dissolved (DOM) and particulate (POM) phases as it moves through a natural environment (e.g. a tidal marsh)

2. Hypothesis

- The marsh acts as a reactor for marine derived POM, converting it to DOM, and that these changes can be traced with absorption and fluorescence measurements

3. Objectives

- Analyze optical characteristics (e.g. indicative of origin and quality) of DOM and POM in a tidally influenced marsh
- Quantify temporal alterations to chemical composition using parallel factor analysis (PARAFAC)
- Capture daily and seasonal variations in the CDOM flux through continuous flow and fluorescence measurements
- Identify the role of this coastal restored marsh system to export DOC to a neighboring estuary

4. North River Farms Wetland Restoration Project - Site description



Dimensions:

- Tidal Creek through marsh: 700 meters
- Restored marsh encompassed with silt fence: 5.7 hectare

One of two sampling houses



Photo credit: http://www.fondriest.com/products/turner_designs_2100-000-u.html



Photo credit: <http://www.geoscientific.com/dataloggers/eureka.htm>

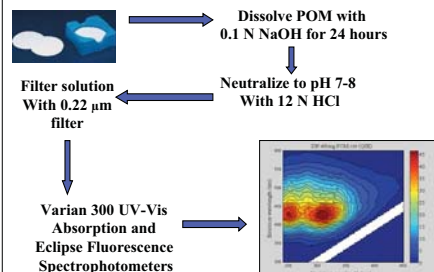
5. Method

Field collections

- ISCO automatic water samplers make hourly collections into 1-L bottles over a 24-hour period; Collections will occur once a month between April - September, 2011
- Continuous measurements with a Manta 2 EurekaTM sensor with Turner designsTM probe and a Spectro::Lyzer probe
 - Conductivity, pH and DO
 - CDOM (C-region)
 - Absorption (UV - Visible)

Laboratory Methods

1. Retentate POM size fraction >0.7 µm for extraction



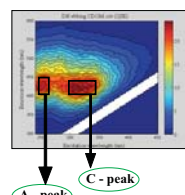
2. Permeate size fraction <0.2 µm for CDOM

What is an EEM?

Table: Fluorescence maxima of previously-identified regions on an Excitation-Emission Matrix (EEM)

Peak	Description	Excitation (nm)	Emission (nm)
A	UV humic-like	340	350-460
C	Visible humic-like	320-360	420-460
M	Marine humic-like	290-310	370-410
N	"New" production; phytoplankton	280	370
T	Protein-like (Tryptophan)	275	340
B	Protein-like (Tyrosine)	275	310

Stedmon et al., 2003



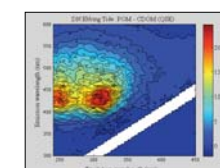
Data analysis using a PARAFAC model

- Multi-variate technique: Sum of EEMs (excitation spectra * emission spectra * intensity) + residuals
- Aides in the identification of unique fluorophores in a DOM pool

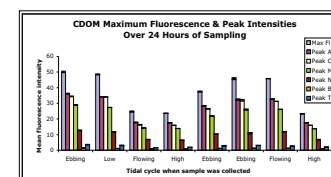
6. Preliminary Results

A. How is the fluorescence of the POM fraction different from the CDOM fraction?

POM EEM - CDOM EEM =



B. First look at CDOM characteristic fluctuations over a 24-hour period, including two tidal cycles:



7. Acknowledgements

- This research will be supported by a Sea Grant-WRRRI 2011 grant - Water Quality: Land-Sea Fluxes and Interactions
- Thank you to the Burchell lab for use of North River Farm photography and map

8. Citation

Stedmon, C. A., S. Markager and R. Bro (2003), Tracing dissolved organic matter in aquatic environments using a new approach to fluorescence spectroscopy, *Marine Chemistry*, 82, 239 - 254.

Abstract

Chromophoric dissolved and particulate organic matter cycling through a tidally influenced restored marsh ecosystem in Eastern North Carolina

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Organic matter in natural waters can undergo rapid transformations between the particulate and the dissolved phase due to physical, chemical and biological processes. In a coastal North Carolina restored marsh, we are quantifying the optical changes of dissolved (DOM) and particulate organic matter (POM) on multiple tidal cycles. We hypothesize that the marsh acts as a reactor for marine derived POM, converting it to DOM, and that these changes can be traced with natural fluorescence. We anticipate that flooding tides bring predominantly marine-sourced POM into the marsh, with a percentage becoming quickly degraded to DOM, which is then exported out of the marsh. Further, we expect this exported DOM is indicative of its source, derived from either autochthonous or allochthonous DOM production, and unique from inflowing DOM. We anticipate that microbial and photochemical reactions occurring during inundation of tidal water also contribute to changes in chemical composition of organic matter exported from the marsh. Fluorescence excitation-emission matrices will be used in the identification of source and degradation state of organic matter.

Our research expands on prior research into the transfer of organic matter between the particulate and dissolved phase of resuspended sediments in natural waters. We demonstrate a new POM extraction method to measure the fluorescence of chromophores present in, and perhaps released from, marine- and marsh-derived particulates. This procedure will be compared to a time-series experiment to determine how closely the lab method mimics degradation of particulates in the marsh. By evaluating these lab results and the optics of the POM and DOM pools collected *in situ*, we will identify the sources and cycling of organic matter in this marsh. Thanks to continuous flow and DOC concentration measurements in and out of the marsh, DOM export loads will also be quantified into the receiving North Carolina estuary.